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☞ *Subscriptions begin with the year.*

Subscriptions are coming in upon us at a very lively rate. The BULLETIN has "waked up to find itself famous" and is already a popular institution. Volume I is nearly out of print, and we shall now have to charge fifty cents for the few remaining copies (seven numbers) in order that those who most value the BULLETIN may be able to obtain a complete set.

A number of our friends are sending in subscriptions for 1886, and even 1887. This is very complimentary, indeed; but please don't—1886 is too far off.

A short article by E. Gundlach on "The Errors of Objectives," that appeared in the *American Journal of Microscopy* (known as *Phin's Journal*) for October, 1877, seems to us to be so full of valuable information that its republication in another column requires no apology.

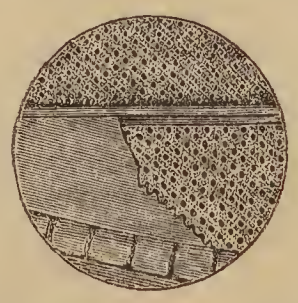
We republish from the *Jour. R. M. S.* portions of a paper by J. D. Cox on the structure of diatoms. He has kindly sent us some excellent photographs and heliotypes (the latter of which appeared in the *Proceedings A. S. M.*); we have selected one of these, as well illustrating two of the points, and have made a sectional engraving from it. Our readers will well understand the peculiar difficulty of representing with accuracy such objects in a wood engraving, but we think they will admit we have succeeded reasonably well.

On Some Photographs of Broken Diatom Valves, taken by Lamplight.

BY JACOB D. COX, LL.D., F. R. M. S.

In a series of articles recently published,* I gave the typical examples of numerous observations, which I considered to warrant the following conclusions:

(1) The diatom shell is usually formed of two laminæ, one or both of which may be areolated, and may be strengthened by ribs, which have been described both as costæ and as canaliculi. (2) The normal form of the areolæ is a circle, and these, when crowded together, take an hexagonal and sub-hexagonal form. (3) The areolæ are properly pits or depressions in the inner surface of one of the laminæ, so that when two laminæ are applied together, the exterior surfaces of the shell thus formed are approximately smooth and the cavities are within. (4) The apparent thickening on the exterior of the lines bounding the areolæ in some species, as *Eupodiscus argus*, etc., is not in contravention of, but is in addition to, the formation above described. (5) However fine the dotted marking of diatom valves may be, the evidence from the color of the spaces between the dots, and of the dots themselves, supports the conclusion that they follow the analogy of the coarser forms, in which both fracture and color are found to prove that the dots are areolæ and the weaker places in the shell.



Mastogloia angulata, Grun. x 1015, exposure 10 min. Showing segment broken out, with fracture through the dots and along the median line. From Peticolas' balsam mount of diatoms from Long Island Sound.

I have now sent to the Society, through the courtesy of Mr. Mayall, a parcel of photographs of broken diatom shells made by lamplight.

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* *Am. Mo. Mic. Jour.* (1884), pp. 45–9, 66–9, 85–9, 104–9; *Jour. R. M. S.*, p. 943.

They are intended as a contribution to the evidence as to the structure of the diatom valves, and were prepared under the strong belief that the study of broken specimens has not been followed up with the systematic care which their instructiveness would justify.

In my investigations, extending over a considerable number of years, it has been my habit to mark by the Maltwood finder and enter in my note books the more suggestive examples of broken valves which I found, and especially such as seemed to throw useful light upon the question of structure. How to make this evidence available was a somewhat troublesome problem; but it is one which recent improvements in dry gelatine plates for photography seem to have solved very happily. * * *

Without pretending to be sure that my method is the best, I will still say that I have thus far got the best results by using the no. 1 eye-piece in the microscope, and no other amplifier. It seems to me that, after correcting the objective with care, so as to present the best results to the eye directly, the satisfactoriness of image which is thus produced is best kept by using both objective and eye-piece in photographing precisely as in ordinary observation, and with the same length of tube, changing nothing but the fine adjustment to correct the focus for the position of the camera screen. Such, at least, is the conclusion I have tentatively reached.

The thing I have specially aimed at has been to correct the objective by the collar with the utmost care, to procure sharp definition of the broken edges of the valves, and to reduce the diffraction as much as possible, also by this means and by the manipulation of the light. After patient experimenting to secure this, I place the tube in a horizontal position and attach it to the camera, with as little change of conditions as may be. I use an achromatic condenser, which is a slight modification of a Kellner eye-piece, with violet-blue modifier and a variety of movable diaphragms and stops at the back. These were not specially provided for photography, but, being such as I am in the habit of using in actual investigations, I have, on the principle before stated, continued their use with the camera.

With the exceptions of one or two negatives, my photographs have been made with light strictly central; for I have sought to secure dioptric images, and so avoid diffraction ones as far as possible. From the list of the photographs it will be seen that the objects have been mounted, some of them dry, some in balsam, and some in the very dense medium of Professor H. L. Smith. While both the denser medium and the dry mounts have their advantages for purposes such as the resolution of lined surfaces by oblique light, it should be remembered that by the exaggerated contrast in the refractive power of the object and the medium, the prismatic effect of a broken edge is increased. This exaggerated refraction and accompanying diffraction interferes more or less with the true presentation of such a marginal broken line. At first sight it seems much stronger and bolder, and what is coarsely presented is much more easily photographed; but my experience leads me to the opinion that the most truthful presentation of the details is given when the difference in the refractive indices of object and medium is as small as is consistent with the discrimination of the object. The image will, of course, be much fainter, but I find it also more delicately exact and of a better quality.

Up to the limit of good definition in balsam, therefore, I prefer to use mounts in this medium, and the result seems to be worth the extra care and nicety required in all parts of the manipulation. * * * * * * * * *

I will only add that it has been a fixed rule with me to leave the photograph untouched. Any "stopping out," stippling, or retouching in any of the forms known to practical photographers must, in my opinion, greatly diminish the value of a photograph for scientific purposes, by introducing more or less of personal interpretation.

So much as to methods. The facts in structure, of which the photographs are evidence, are these:

(1) The character of the costæ in *Navicula major* (*Pinnularia* W. Sm).

(2) The existence of films of silex above and below the large hexagonal cells in *Triceratium favus*, *Coscinodiscus oculus-iridis*, and *Heliopelta*.

(3) That the "dots" of the diatoms are areolæ, as shown by the fractured edges of a considerable series of examples, ranging from the coarsest to *Pleurosigma angulatum* inclusive.

I do not mean to repeat here the discussion of the subject, but only to present the photographs as illustrative of what I have said in the series of articles which has been mentioned. * * * —*Jour. R. M. S.*

Pollen Tubes.

In a paper "On the Fecundation of Ovules in Angiosperms," by J. Kruttschnitt, of New Orleans, read at the Rochester meeting *A. S. M.*, he states:

The results of my investigations may be summed up as follows:

The pollen tubes as they are found on the stigma lose their separate existence; they discharge their contents amongst the papillæ of the stigma, which may be considered the aggregate head of the fibrillæ of the conducting tissue which is found in the style and in the various parts of the ovary, impregnating thus the whole ovary as an entirety, with the substance of the pollen which has been absorbed by the papillæ of the stigma. The existence of the nucleus in the pollen grain is problematic, and its fusion with the oosphere in the embryo-sac has not become an observed or a demonstrable fact; therefore, by ignoring it science will not be wronged.

Microscopy in West Chester.

We know of no place for its size where there is displayed so much interest in scientific matters, and especially in microscopy, as in the quiet little Quaker town of West Chester, Pa. There are two scientific societies, well supported—the "Philosophical" Society and the "Microscopical"—the latter of which is the older. The meeting of this society, held on the evening of March 5th, was an interesting one, and below we give a short notice of it published in one of the local papers.

The commodious and beautiful parlors of the residence of Samuel L. Fox, on Virginia avenue, this borough, were thronged last evening with an assemblage of those of our citizens who are attracted by the microscope, the discussion, and the sociability of our scientific societies. The topic under consideration for the evening was food adulteration. Mr. Fox had brought with him from the store of Messrs. Queen & Co., opticians, of Philadelphia, eight of the finest grade of microscopes, and these, with about as many more belonging to other members of the Microscopical Society, were used to display a set of slides illustrative of foods and the adulteration of foods. Among the food slides exhibited were starch of wheat, maize, barley, potato, root of ginger showing starch, starch by polarized light, coffee with rye, wheat with plaster, allspice with cedar wood, Chinese cinnamon, cassia cinnamon, cinnamon bark from Ceylon ground pepper, allspice, and chocolate. There were also some beautifully clear photographs of magnified objects, the work of Dr. George A. Piersol, of Philadelphia, and of Hon. J. D. Cox, of Cincinnati, the latter of diatoms.

The meeting was called to order a few minutes past eight o'clock by the president, J. Hunter Worrell. After the transaction of some routine business, Professor C. B. Cochran, of the State Normal School, was called on for the address of the evening, on food adulteration and its detection. He defined an adulteration to be any substance which is introduced into an article of food which should not be there. The chief methods of determining adulterations is by the microscopic examination and by chemical analysis. If the adulteration is vegetable or organic, the microscopic test is efficient; if mineral, the chemical is the best.

Plants differ in the character of their cells, and they differ in the characteristics and appearance of the cell contents. The most abundant substances contained are starch, chlorophyll, etc Perhaps there is none more common than starch. In all flowering plants, in potatoes, in beets, in grains, etc., starch abounds. Speaking of starch in general, the Professor said that it occurs in various sizes and shapes, ranging from over one three-hundredth of an inch in diameter to less than one three-thousandth of an inch in diameter, and of many shapes. He described grains of starch as they occur in rye, wheat, barley, cinnamon, potatoes, etc. Of the mineral adulterations of wheat-flour that have been discovered in it, are gypsum, carbonate of lime, alum, etc. Mustard is adulterated with flour, turmeric, etc. The adulteration of milk was touched on and the amount of solids required to support the life of an active man. Tests were given for the detection of starch, of alum, and of other impurities.

Dr. Clemson spoke of the use of ground cornmeal cakes in adulterating spices. Mr. Fox exhibited two specimens of adulterated tea which had been condemned by the tea inspectors of New York, describing each, the process of adulterating it, and the methods of detecting it. Dr. Rothrock spoke of adulterations by black lead, and said that even the cigars we smoke are sometimes made of old stumps pressed together. Mr. Fox, on being questioned further, told of the manufacture of tea from willow leaves in Shanghai and of adulteration of pepper with cocoanut-shells in Camden. Dr. Dunn thought adulteration ran through all lines of trade, and the drug business is far from exempt. Dr. Jackson's commended Professor Cochran's remarks for their non-sensational character. By request of Addison May, Esq., Professor Cochran performed a few simple tests before the audience.

Professor Phillips spoke of the zodiacal light visible in our western sky these evenings just after sunset, and showing with unusual brilliancy.

The motion to adjourn was carried and the audience rose to inspect the microscopic display.

Salmon's Culture Tubes and pipettes, as described and illustrated on page 12, are now ready for delivery, at the following prices:

Culture tube with supply of glass wool, $1 25
Pipette, ...20

Bureau of Scientific Information.

With a view toward the more general dissemination of the results of scientific investigation, and of facilitating the work of the student in natural history, the following members and officers of the Academy of Natural Sciences of Philadelphia, have associated themselves into a Bureau of Scientific Information, whose function shall be the imparting, through correspondence, of precise and definite information bearing upon the different branches of the natural sciences. It is believed that through an organization of this kind considerable assistance can be rendered to those who, by the nature of their environs, are precluded from the advantages to be derived from museums and libraries.

As the organization is of a purely voluntary character, it is to be hoped that no unnecessary burden will be imposed upon its members by communications of an essentially trivial nature.

All correspondence must be accompanied by a return stamp (two cents).

It is to be clearly understood that the scope of the organization does not embrace considerations of a purely professional character—such as mineral or chemical analyses—nor the determination of collections, except by special agreement.

The above startling announcement—startling for its spirit of disinterested generosity—is made by men whose reputation as specialists is national or even world-wide. In the special line of microscopy, we may mention Dr. Joseph Leidy (mycetozoa rhizopoda, entozoa, vert. paleontology), Edward Potts (pond life, fresh-water sponges, and bryozoa), Dr. Benjamin Sharp (worms, annelids, histology), Dr. J. Gibbons Hunt (microscopical technology). Those interested should obtain a circular from the secretary of the Bureau, Professor Angelo Heilprin.

It is recommended to ring slides with Hollis' glue to protect against the influence of the oil used with homogeneous immersion lenses. Now we don't know the composition of this cement, but would not "stratena" (which appears to be glue made fluid by the addition of a small quantity of acid—commercial acetic, or nitric) answer well? We recommend the trial of this as a cell-substance and finish for objects mounted in various oily mediums. Our colorless marine glue would probably answer the same purpose.

A New Form of Culture Tube.

By D. E. Salmon.

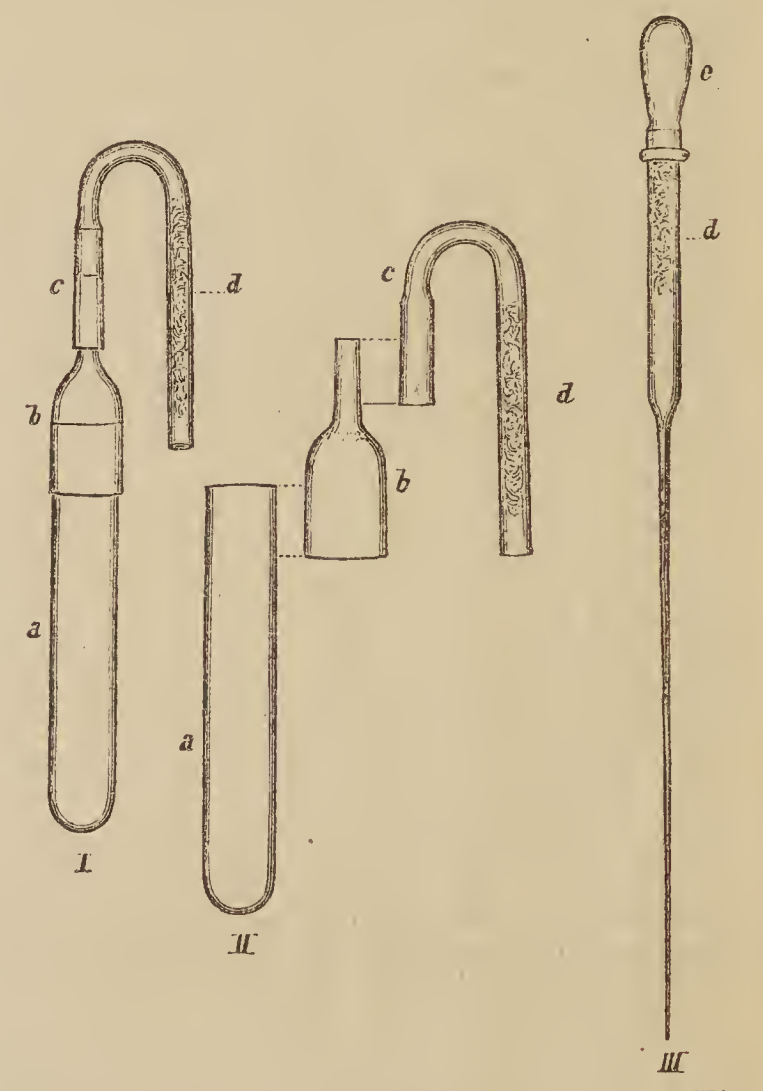
The necessity of obtaining absolutely pure cultures of bacteria for the study of their biological properties has led to the development of a very delicate technique and to the adoption of various forms of culture apparatus by different investigators. To many of these, from the standpoint of to-day, there are almost fatal objections; others, used perhaps with great skill and dexterity by their originators, may fail completely in the hands of those not accustomed to them. To be sure, a certain amount of skill and a quick appreciation of possible sources of error must be presumed in the study of the Schizophytes, whatever methods and apparatus be employed.

The culture tube described below, which has been devised by me more especially for the study of pathogenic bacteria in connection with the contagious diseases of animals, requires, I believe, less of this initial store of manual dexterity and eliminates more sources of error than the great majority of tubes now in use.

To those who are engaged in this field of research the following description and suggestions will speak for themselves:

The culture tube (see figure) consists of a test-tube like body or reservoir (*a*) of rather heavy glass from four to five inches in length and three-quarters of an inch in internal diameter. Over the top of this reservoir a second hollow piece (*b*) is fitted, which might be called a cap. Its internal surface is ground to fit snugly over the ground external surface of the upper end of the reservoir, thus forming a ground joint. This cap, two and a half inches long, abruptly contracts near its middle into a narrow tube, having an internal diameter of about three-eighths of an inch. The third piece (*c*), which might be called a ventilating tube, is shaped like an inverted U, with limbs of unequal length. The shorter limb, about one and a half inches long, fits over the narrow tube of the cap by means of a ground joint. The other free limb, about three inches long, lodges a plug of glass wool (*d*) from one and a half to two inches in length. The tube itself, when the parts are in position, measures from seven to seven and a half inches. A little sublimated vaseline is rubbed upon one of the joint surfaces to prevent them from tightly adhering to each other after they have been subjected to a high temperature.

The culture liquid is introduced by removing the cap, which brings with it the ventilating tube. From ten to fifteen centimeters will be sufficient, though the reservoir will hold con-



veniently twenty-five cubic centimeters. The form of the latter may be changed to suit circumstances. The lower end may be enlarged, so as to become flask-shaped, where microorganisms requiring an abundance of oxygen are to be cultivated. The test-tube form will be found generally applicable, however, by varying the quantity of the culture liquid. Sterilization of the latter is effected in the tubes either by discontinuous boiling or, better, by

raising at once, in a steam-tight boiler, to a temperature of one hundred and ten degrees C. * * *

The pipette, employed to introduce and transfer small portions of cultures, consists of an ordinary glass tube about one-quarter inch diameter and from two to three inches long, one end of which is drawn out into a very fine, almost capillary prolongation, which must be long enough to reach the bottom of the reservoir when introduced through the narrow portion of the cap. A plug of glass-wool (*d*) occupies the tube near the other extremity, which is surmounted by a rubber bulb (*e*) * * *

The culture tube recommends itself also for the readiness with which it is filled, sterilized, and inoculated. A perusal of the experiments of older investigators is sufficient to impress this upon the mind. No plug need be disturbed, no tubes sealed or broken, no spray or antiseptic dressing employed. Its manipulation is safe, as no sharp, jagged edges need be feared when a dangerous culture is being prepared. The tubes are readily cleaned, and may be employed over and over again, so that the initial cost cannot be cited as an argument against them and in favor of home-made apparatus, which requires outlay for material and time for its preparation. The form of the reservoir is very well adapted for a careful microscopic examination of the culture. The faintest turbidity or cloudiness is readily recognized. The concave bottom reveals the earliest trace of sediment, while the beginnings of a surface membrane are as easily detected. Perhaps the greatest advantage consists in the facility with which small portions may be withdrawn, more especially for repeated microscopic examinations. Those who have devoted much time to the Schizophytes will certainly appreciate this. By proper management of the pipette, portions of the deposit of the liquid or of the membrane, if this be present, may be withdrawn separately for examination. This differentiation, as it were, of the culture is greatly favored by the form of the reservoir. Portions of the membrane are more conveniently withdrawn with a looped platinum wire or a needle.—*Report of Bureau of Animal Industry, Department of Agriculture.*

[The method of use, sterilizing the pipette, etc., transferring a drop of "culture liquid" containing the organism to be sown from one culture tube to another, that only pure cultures may be obtained, are then given at some length. We regret that we cannot afford space to republish all We are prepared to supply those who want to experiment in this line; see note on page 11.—ED. MIC. BULLETIN.]

Chips.

THE COUNCIL of the Royal Microscopical Society has voted the sum of five guineas as a contribution from the society to the R. B. Tolles memorial fund of the American Society of Microscopists.

DR. THOMAS SHIPLEY BARTRAM, a well-known physician of Philadelphia and a lineal descendant of John Bartram, the celebrated botanist, died at his home in this city on February 2d.—*Ex.*

DR. GEORGE M. STERNBERG (U.S. Army) is continuing his work at the Biological Laboratory of Johns Hopkins University. He is investigating the relative power of the different disinfectants for the National Board of Health. —*Ex.*

A NEW BOOK is announced to be issued soon—*The Methods of Microscopical Investigation,* by Dr. C. O. Whitman, editor of the Department of Microscopy in the *American Naturalist.* Announcement will be made when ready.

OUR FRIEND, Dr. H. H. Chase, of Geneva, N. Y, is about to issue an edition of Habirshaw's *Catalogue of the Diatomaceæ,* containing, in addition to the original, references to all works published up to the present time. The price will be twelve dollars, bound in cloth. Subscriptions will be received by us.

THE Executive Committee of the American Society of Microscopists have very wisely appointed Mr. C. M. Vorce, of Cleveland, Ohio, as committee in charge of the session for practical work at the next meeting of the society, and it is to be hoped every one who can help will heartily co-operate in making that session a grand success.—*A. McCalla.*

A GENERAL DENIAL.—T. R. Lewis denies the validity of Dr. Koch's conclusions as to the "comma-shaped" bacillus being the cause of cholera, as bacilli identical in size, form, and in their reaction with aniline dyes with those found in choleraic dejecta are ordinarily present in the mouth of perfectly healthy persons.—*Nature.*

IN THE *Medical Bulletin* for March, Dr. A. P. Brown calls attention to a very delicate test for albumen in urine, namely, a saturated solution of picric acid in water, which when added to the urine a few drops at a time, will cause a cloudiness to appear, even if albumen be present only in minute quantity. The writer goes on to say that if quinia, or other alkaloid, or urea, be present, it will cause a similar precipitate; but the writer discovered that if then you add a few drops of nitric acid to the urine, if it is urea, or an alkaloid, it is instantly cleared up; but if it is albumen, instead of its clearing up, the precipitate becomes more dense.

THE APERTURE OF OUR $\frac{1}{15}$ homogeneous immersion lens is now increased to 1.25 (numerical). The price remains at the same very low figure (fifty-five dollars), while the performance is of the highest class. *A. pellucida* is an easy test, and it dots *N. rhomboides* in phosphorus most perfectly. Reference will be given to prominent microscopists who know the objective, if desired. Fluids for central and oblique light, with directions for use and care of the lens, are furnished with each.

Practical Questions and Answers.

1. What is the best medium for imbedding leaves and plant stems in the well of the microtome?

I have not had the *best success* by the use of any "medium" which I have attempted, nor in the use of a microtome with a well.

I use soft cord or the pith of cornstalk or elder, or any other material that will yield to the pressure of the stem or leaf, shaping the material as nearly as may be to the form of the stem or leaf to be cut.

Vegetable stems or leaves should be cut immediately after they are broken from the plant. To imbed them, they must be more or less dried out. In drying they shrink; shrinking compresses the stem, which, of course, distorts its internal structure, and the sections will not show the true structure

Rivet's pattern of microtome is the most convenient I have seen for cutting such material.

WILLIAM HUMPHREY,
Adrian, Mich.

2. What is the best microtome for cutting vegetable sections, such as woods, barks, roots, etc?

I do not undertake to say which is the best. For wood, I use a carpenter's vise, and a very finely set carpenter's smoothing plane. Then select from the shavings for sections; same for barks and hard roots.

WILLIAM HUMPHREY,
Adrian, Mich.

Boil the wood until soft, and then fasten in microtome well and cut with a sharp chisel.

B. F. QUIMBY,
Chicago, Ill.

3. What is the best method for sharpening the knife for cutting vegetable sections?

I use a fine hone, finishing on a razor strop, holding the knife close to hone, so that the back touches. The knife needs sharpening oftener while used for vegetable sections than when cutting animal tissues, because of the presence in vegetables of a great abundance of crystals.

WILLIAM HUMPHREY,
Adrian, Mich.

4. What is the best method for breaking down Barbadoes earth before boiling?

A saturated solution of citric acid, which acts on the iron more promptly than the mineral acids.

F. S. NEWCOMER, M. D.,
Indianapolis, Ind.

5. What is the best size for holding diatoms in arranged slides?

Febiger's size, as follows: Acetic acid, twelve drachms; photographer's gelatin, two drachms; alcohol, one drachm.

Use a porcelain dish; add acid to gelatin, and stir in a water bath until dissolved; then add the alcohol and filter; spread on slide with fine needle. F. S. NEWCOMER.

6. What is the best method of eliminating flocculent matter from diatoms after boiling?

For large forms boil in pure soap; let diatoms settle, and pour off soap and water. For small forms I prefer aqua ammonia.

F. S. NEWCOMER.

7. What diatomaceous material is most easily cleaned, and where found?

Of fossil earths, perhaps Cherry Hill, Me., or electro-silicon, a polishing powder, found at the stores. Professor H. L. Smith's method of boiling in soap and water is all that is needed.

X.

8. What are some of the most interesting microscopic crystals?

The chemical crystals I have found most interesting, and many of which I have prepared, viz.: salicin, santonin, helicin, asparagin, aspartic acid, bichromate of potash, arsenious acid, cinchonoidine, hippuric acid, oxalate of ammonia, quinidin, sulphate of cadmium, sulphate of copper, chloride of copper, platinocynide of magnesium, pyrogallic acid.—*Proceedings A. S. M.*, 1884.

New Abbe Condenser.

We are prepared to furnish a new Abbe substage condenser, complete with central stops (for dark ground), diaphragms with adjustments for obtaining oblique light, cap for front lens, all in neat, compact, and convenient shape, and of excellent workmanship; price, twenty-two dollars. If the lens system of extreme aperture be required, the price will be twenty-six dollars.

The Examination of Objectives.

BY ERNST GUNDLACH.

The quality of each objective depends upon: (*A*) the degree to which the correction of the spherical aberration has been carried; (*B*) the degree to which the correction of the chromatic aberration has been carried; (*C*) the angle of aperture; (*D*) the working distance; (*E*) the centering; (*F*) the power of transmitting light.

Each of the two aberrations subdivides again into three parts, viz.: *A*, the spherical, into (1) the general spherical aberration, resulting from the fact that the rays passing from any one point of the object through the objective, do not reunite in one point, the point of union for the peripheral rays lying nearer the objective than the one for the central rays. (2) The so-called distortion, which occurs when the rays come from any one point outside of the axis (sideways) and, passing through the objective, do not reunite in one point. This is due to faulty construction of the objective. (3) The spherical aberration of the higher order.

The chromatic aberration *B* subdivides into (1) the general chromatic aberration arising from the fact that the different colored rays have, on account of their varying refran-

gibility, different foci; (2) the aberrations of the higher order, manifesting themselves when the central part is still under-corrected, while the parts near the edges are already over-corrected; (3) the distortion of colors, arising when only the colored rays coming out of the axis reunite in one point, but not those coming from a point lying outside the axis (sideways), which is the consequenee of a faulty construction of the objective.

A (1) is, when present, most easily recognized in powerful objectives, especially immersion objectives, by observing therewith objects with fine lines, for instance, the *P. angulatum*, as the lines of these appear to be not exaetly in the plane of the outlines of the object, but somewhat below, so as after the outlines have been sharply defined, the objective has to be approached somewhat to the object by means of the fine adjustment, to bring out the lines in the sharpest manner. If, however, it is necessary for the same purpose to move the objective further off spherical over-correction is present.

This test is applicable with more or less difficulty to all objectives and with all such objects which show fine lines on the surface.

A (2). This defect is known to be present when the object appearing at the edge of the field of view appears poorly defined, and in such a way as if a number of images seemed to lie above the other, but displaced in the direction of the centre.

A (3). The spherical aberration of the higher order can only be measured by the defining power of the objective. It will be the less the more the general aberration has been corrected by means of the front lenses (consequently, also, by immersion), instead of by a corresponding form of the flint glass lens, as that part of the correction of the aberration affected by the former method leaves no aberrations of the higher order, which latter is always the case for that part of the aberration which is corrected by a corresponding form of the flint glass lenses.

B (1). The general chromatic aberration becomes apparent if the object, when slowly moved out of the focus, appears with blue or orange colored borders, these borders appearing blue when the distanee between the objective and the object is *increased*, orange when *lessened*. If, however, these colors appear in reversed order, that is, if the edges are bordered with orange when the distance between the objective and the object is increased and blue when it is decreased, then the objective is over-corrected. It is properly corrected when on moving the object away from the objective faint yellow green, and on approaching faint violet borders appear (secondary spectrum).

B (2). The chromatie aberration of the higher order is recognizable in this way, that with oblique illumination that side of the object image which is turned away from the illuminating mirror shows a lively orange border, while the other side shows a lively blue border. It is not present if in place of the first named color there appears a faint yellow green, in place of the last one a faint violet. It is the less the more the general chromatic aberration has been corrected by thickening the front lens (or by immersion) instead of by a corresponding form of the flint glass lenses. In fact, the thicker the front lens of an objective, the less the negative action of the flint lens is necessary to remove the color phenomena. That part of the eorrection of the chromatic aberrations which is effected by the thickening of the front lens is perfect and leaves no aberrations of the higher order and no secondary spectrum.

B (3). The distortion of color is a consequence of faulty chromatic symmetry of the objective. It can be recognized by this, that with the correct achromatism of the image in the middle of the field, the image on the edge thereof has on the side turned toward the centre a blue, on the other side an orange colored border; or, it may be in reversed order, an orange colored border on the side toward the center, and a blue one on the other side. In the first case, the chromatic aberration of the objective is preponderatingly corrected by that half of it which lies above the plane of the equivalent lens of the objective; in the latter case, the reverse. If, however, these corrections are accurately distributed in the objective, that is, if each one of the two halves of the objective have an equal share of it, or, in other words, if the objective is chromatically symmetric, then the image on the edge of the field will appear just as colorless as the one situated in the middle. If, then, the spherical distortion (*A* 2) is also removed, the image on the edge of the field will appear quite sharply defined. With powerful objectives of large angles of aperture, the latter cannot be perfectly accomplished; as perfect spherie symmetry is impossible in such a case. (*To be concluded.*)

The Cheapest Antiseptic.

Those familiar with the character of bisulphide of carbon, and especially with its noisome odor, will be interested in the following item from the Boston *Journal of Commerce*:

M. Pasteur anticipates that bisulphide of carbon will become the most efficacious of all antiseptics, as it is also the cheapest, costing but a fraction of a penny per pound in large quantity. It is also the best insecticide known, and for this purpose may, perhaps, be useful to preserve wood-work in tropical countries. Some idea of the use it is already put to may be gathered from the fact that over eight million pounds of the substance are used annually to check the ravages of phylloxera. Carbon bisulphide, as first produced, is about as foul smelling a compound as it is possible to find; but it is capable of purification till all offensive odor is removed, and it is sufficiently pure in smell almost to mix with a perfume.

Felting of Wool.

Captain George R. Case, of Hartford, by many careful experiments, detailed by J. Dawson in

the Boston *Journal of Commerce* for January 31st, has become satisfied that the felting property of wool is not due to the serratures upon the hair, but to its curliness. From the article we extract the following paragraphs, which will be of interest to our readers.

A number of fibers, placed side by side with the roots and tips alternating, with a slight tension just enough to straighten the fiber, when manipulated in soap, have no fulling or felting property, and no power of adhesion.

A number of fibers, placed side by side with the tips all one way, or with the roots and tips alternating, *without* any tension, *have* fulling properties. * * * * *

After several ineffectual attempts, I succeeded in getting a very fine sample of negro's hair (of the very best blood), sufficient in length to justify an experiment in fulling. It was examined with the aid of a microscope and the construction noted. The fibers differed somewhat in their external formation. Some were oval, some flattened on one side and convex on the other. All with a slight spirality, which formation in all probability accounts for the characteristic curl or kink. The fiber was comparatively free from the serrations so conspicuous in wool fibers. The result of manipulating this hair in the same manner and in the same lubricant was a very well felted sample of cloth, which I now have in my possession.

These are a few of the experiments which prove to my mind that the fulling properties of wool, or any other fibers, are in proportion to the number of weaves, curls, or kinks, and their degree of fineness, and that the serrations *per se*, have comparatively little to do with the matter, excepting possibly that which may be due to friction.

Botanical cases (plant-collecting boxes, of vasculums) are now in stock ready for spring work. We have two sizes, neatly japanned (*inside and out*) a plain dark brown. Prices, $1.50 and $2.00. For illustration and fuller description see MICROSCOPICAL BULLETIN, April, 1884. Special estimates will be given for supplying classes.

Wanted, a complete set of the *Journal of the Royal Microscopical Society* from 1878 to 1884 inclusive. Address, stating price, J. W. Q. & Co., Dept. No. 3.

Razors ground flat on one side for cutting sections will do good work and are much less expensive than the regulation "knife." To supply the demand we now keep them in stock; price, $1.50. In ordering, state whether a "push" or "draw" knife is wanted (if you are left-handed, state this also, but we suppose all microscopists to be dexterous—in the original meaning of the term—unless advised to the contrary).

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New Publications.

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A valuable record of one of our best meetings, issued in first-class style in every respect. The table of contents is an attractive one; we wish that we could spare the space to reprint it here.

UNITED STATES DEPARTMENT OF AGRICULTURE. First Annual Report of the Bureau of Animal Industry for 1884. From D. E. Salmon, veterinarian.

Of special interest to microscopists and "microbists" is the description of Dr. Salmon's new and wonderfully convenient culture-tubes and their method of use. There is also a large amount of other matter of great interest to all who want to know what's new regarding "disease germs." The Department is doing a good work in this field.

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* * *

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